Dating Lapita Pottery in the Bismarck Archipelago, Papua New Guinea

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PREHISTORIC SITES WITH POTTERY known as Lapita have been the focus of archaeological attention in the western Pacific for more than thirty years. For much of this time the main concern has been with the relationship between Lapita pottery and the origin and spread of people who were the ancestors of the Polynesians. Whereas in the Solomon Islands and Papua New Guinea Lapita pottery appears in the archaeological record many millennia after the first human entry into the region, in Western Polynesia—and possibly also in New Caledonia and Vanuatu—the carriers and users of Lapita pottery appear to have been the first humans to colonize these island groups. For Kirch and Hunt (1988a:161), this expansion of Lapita pottery-using people from Papua New Guinea to Samoa "may be among the most rapid dispersal events in human prehistory." As Spriggs (1990:17) has noted, this claim warrants further assessment. The reliable dating of Lapita pottery is thus important because changes in its chronology may affect interpretations of the nature and speed of its dispersal throughout the southwestern Pacific. Kirch and Hunt (1988a) accept a date of cal. 3550 B.P. for the appearance of Lapita pottery and propose that it spread extremely rapidly from the Bismarck Archipelago in Papua New Guinea to Western Polynesia, with no statistically significant time difference between northern and southern sites. Spriggs (1990) prefers a slightly later starting date of cal. 3450 B.P. and sees the northern sites as slightly earlier than those to the south, thus allowing time for Anson's (1986) "Far Western Lapita" developmental stage of the decorative system in the Bismarck Archipelago. The difference between these two interpretations derives primarily from Spriggs's critical assessment of the dated samples. He rejects several because of undemonstrated or doubtful association between the samples and the pottery occupations, in particular five of the earliest samples on which Kirch and Hunt base their chronology. Both papers, however, are concerned with the chronology of the pottery throughout its distribution and do not examine closely any one area. This paper addresses issues of dating for sites in the Bismarck Archipelago (Fig. 1), widely regarded as the "homeland" of Lapita pottery, whence the

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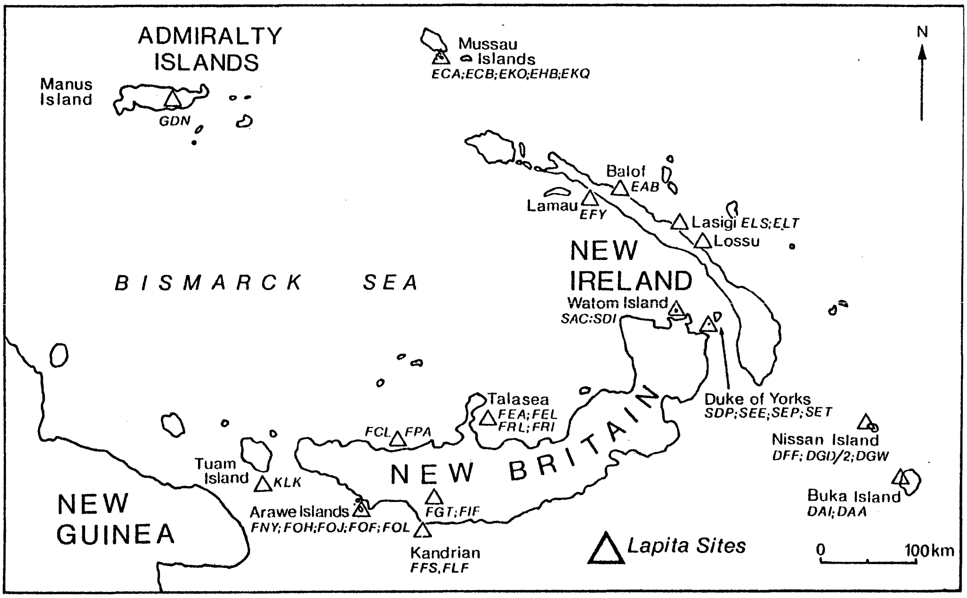

Fig. 1. The Bismarck Archipelago, Papua New Guinea, showing the location of sites mentioned in the study.

knowledge and skills for its production were carried south and east, eventually into Western Polynesia (e.g., Allen 1984, 1991; Green 1979; Spriggs 1984).

The main aim of the paper is to assess the dating evidence for the introduction of Lapita pottery into the Bismarck Archipelago. However, the pottery cannot be separated either physically or conceptually from the sites in which it is found or from the other artifactual elements of those sites. Taken together, the nature of the sites and their included artifacts also raise questions as to the meaning of the Lapita phenomenon in human terms. We feel that the new dates presented here, when set into the context of existing dates from the region, throw new light on whether Lapita sites or the artifacts in them were intrusive and possibly indicative of population movements into the region. We return to these issues at the end of the article.

We present 24 dates (Appendix 1) for Lapita dentate-stamped pottery, or for stratigraphic contexts bearing on the date of its appearance, for sites in West New Britain Province, Papua New Guinea. We compare them with dates from other sites in the archipelago and suggest that two interpretations are possible. First, if the earliest dates accepted by Kirch are valid, Lapita may have begun in the Mussau Islands slightly earlier than in New Britain. Alternatively, if the earliest Mussau dates are not supported, Lapita pottery may have started throughout the archipelago later than the accepted calibrated date of 3450–3550 B.P. (Allen and White 1989; Green 1979:32–34; Kirch and Hunt 1988a, 1988b; Kirch et al. 1991; Spriggs 1990). Both views raise questions about the presence of Lapita in this region.

MATTERS OF CALIBRATION

Spriggs (1989) introduced the idea of "chronometric hygiene" to discussions of radiocarbon dates to screen out samples of dubious material, origin, or result. This has been developed further by Anderson (1991) and Spriggs and Anderson (1993) into a protocol for the evaluation of samples and dates. Some of these criteria are not relevant for many of the samples considered here, and we employ only those relating to sample context, stratigraphic security, vertical consistency, and the possibility of "old wood."

All dates discussed are calculated on the half-life value of 5568 years, adjusted for isotope fractionation with either a measured or estimated value for δ13C (Stuiver and Polach 1977; Stuiver and Reimer 1993). Appendix 1 gives the measured values for δ13C where available; estimated values are indicated by (E). Measured δ13C values for all materials may vary slightly from the estimates, but have only a small effect on the corrected ages (Clark 1993; Taylor 1987:122–123).

The 13C corrected dates are calibrated with the CALIB 3.0.3 program (Stuiver and Reimer 1993). We do not apply the Southern Hemisphere correction factor for atmospheric samples because of the closeness of the sites to the equator, and we use a laboratory error multiplier value of $K = 1.0$. There is no measured Delta R value for marine samples in the Bismarck area, but Chappell and Polach (1976, 1991) have determined an Ocean Reservoir Effect value of −400 years for localities at Huon Peninsula, near the western end of New Britain. We use this value in conjunction with the bidecadal atmospheric calibration curve (cf. Bard et al. 1993; Pearson and Stuiver 1993; Stuiver and Pearson 1993). Ages are calculated by Method A and are cited as 2-sigma ranges rounded off to the nearest ten-year interval; range values ending in −5 are rounded upwards. Calibrated ages are cited as years B.P.; uncalibrated ages as years b.p.

WEST NEW BRITAIN DATES

Of the 24 results listed in Appendix 1, 22 have not been published previously and two (SUA 2814 and Beta 34208) have been published in summary form only (Specht et al. 1991). The results come from three sites in the Arawe Islands (FOH, FOJ, FOL) and two at Kandrian (FFS, FLF) on the south coast of West New Britain; one at Yombon (FGT) in the center of the island; and four on or near Willaumez Peninsula (FEA, FEL, FRI, FRL) on the north coast. Three dates are anomalous and are rejected. Site FEL is a beachside location on Garua Island, near Talasea, where dentate-stamped Lapita sherds are eroding on to the beach. Test excavations in 1989 revealed silts and slopewash containing very few sherds and obsidian flakes. This deposit extended down to a brackish aquifer with organic muds over a coral limestone substrate. Wood from the basal muds, at 125–153 cm depth, gave a modern result (NZA 1979:76±56 b.p.), while charcoal from a higher level with pottery is dated to 1050±80 b.p. (Beta 42526:1130–780 B.P.). FEL in fact consists of redeposited materials from a ridge backing the area. The slopes of this ridge have slumped extensively, and the pottery and obsidian in the FEL deposit probably derive from Lapita site FAO on the top of the ridge. The basal date suggests that this slumping was very recent.

Charcoal sample SUA 2976 (480–0 B.P.) from site FEA on Boduna Island is discarded as it yielded an essentially modern result for a level expected to be ca. 2000 years old. Ambrose and Gosden (1991) obtained dates between 3150–2000 b.p. at the same level or just below this sample. The charcoal may be intrusive, reflecting disturbance of the deposit.

The fourth sample rejected, NZA 450 from site FRL at Bitokara Mission near Talasea (Specht et al. 1988; cf. Torrence et al. 1990), was selected to date the palaeosol formed on a tephra from Witori volcano on Hoskins Peninsula. This tephra, known as the W-K2 tephra, covers much of central New Britain from Talasea on Willaumez Peninsula in the north to Kandrian and the Arawe Islands in the south (Gosden et al. 1994; Machida et al. 1996; Specht et al. 1991). The tephra is important because Lapita pottery is never found beneath it, and it thus sets an upper limit for the time of the appearance of the pottery in this part of New Britain. The small charcoal sample was expected to provide a minimum age for the reoccupation of the site following the tephra fall, but the modern result is clearly anomalous.

All but three of the remaining 20 samples came from sites with dentate-stamped Lapita pottery. The exceptions, from FGT and FRL, date palaeosols sealed by the W-K2 tephra and set a maximum age for it. Beta 57773 (4140–3640 B.P.) and SUA 2814 (3850–3370 B.P.: Specht et al. 1991) from unit 4 at FRL (Specht et al. 1988; Torrence et al. 1990) overlap with Beta 45380 (4410–3860 B.P.) for the equivalent level at FIF/2 near Yombon (Pavlides 1993) and with other dates for this tephra (Machida et al. 1996). SUA 2975 (3470–2750 B.P.) from FGT/V at Yombon is the youngest age yet obtained from a palaeosol immediately below the W-K2 tephra. We are uncertain how to interpret this date, since it falls between the next youngest pre–W-K2 sample (SUA 2814: 3850–3370 B.P. at FRL) and the post–W-K2 samples from FGT and FIF (Pavlides 1993; Pavlides and Gosden 1994).

The remaining 17 dates fall into two groups. The first, with four samples, ranges from 4410 B.P. down to 3470 B.P.; the second group has an upper limit of 3390 B.P. and extends to less than 2000 B.P. Three samples in the older group are from the Apalo site (FOJ) on Kumbun Island in the Arawe group (Gosden and Webb 1994): Beta 55457 (3980–3640 B.P.) on wood, and Beta 54170 (4410–3980 B.P.) and Beta 37560 (4070–3700 B.P.) on charcoal. These samples were recovered from basal contexts with obsidian flakes but no pottery. They overlap substantially with dates for pre–W-K2 levels at FRL, FGT, and FIF/2 (see above), and are older than any accepted dates for Lapita pottery. The wood sample was taken from a timber that may have been part of a structure. This, and the two charcoal samples, is unlikely to refer to the Lapita period unless very old "old wood" was used. A simpler explanation is that the samples originated from a pre-Lapita context. Pre-Lapita occupation in the Arawe Islands is demonstrated at Lolmo Cave (Gosden et al. 1994), and by a burial at the Paligmete site (FNY) on Pililo Island (Beta 27941: 4410 ± 70 b.p. on *Tridacna* shell) (Gosden 1989:55, where the sample is incorrectly cited as Beta 28223 and 3960 ± 70 b.p.).

The fourth date in the "older" series comes from the Lapita open site FFS at Auraruo on Apugi Island near Kandrian. This shell sample (Beta 63613: 3830–3470 B.P.) came from just below the top of calcareous beach sand buried under clay slopewash. The Lapita occupation at FFS appears to have been on the surface of this beach, although sherds and obsidian flakes occur down to 30 cm below the beach surface, presumably incorporated into the loose sand-shell-coral rubble matrix as a result of human and other activities. Beta 63613 is so much older than other accepted Lapita dates that it is likely to refer to the formation of the beach rather than to the age of the pottery.

The oldest date in the "younger" series, Beta 63616 (3390–2960 B.P.—shell), refers to dentate-stamped Lapita sherds in Alanglongromo rockshelter (FLF) near Kandrian, which has a pre-Lapita occupation beginning around 4500 B.P. The sample range just overlaps with another shell date for the same layer at this site, Beta 57767 (3060–2750 B.P.), which is well within an acceptable range for Lapita. The two samples came from within 5 cm depth of each other, but in different parts of the trench. The associated pottery includes, in addition to dentate-stamped designs, incision and fingernail impressions. These are generally not regarded as part of the earliest Lapita pottery. This is supported by a shell sample from the immediately post-Lapita layer (Beta 79348: CAMS 18944), which places the end of Lapita at this site prior to 2140–1890 B.P. Sample Beta 63616, therefore, could refer to pre-Lapita use of the shelter. The next oldest shell age, Beta 41578 (3260–2880 B.P.), came from the base of the FEA site on Boduna Island near Talasea, 20–30 cm below two previous shell samples in the 3060–2720 B.P. range (Ambrose and Gosden 1991).

Seven other results from the Arawe Islands fall within the main range of Lapita dates: from FOH (Makekur), on charcoal, Beta 54164 (2930–2480 B.P.), Beta 54165 (3210–2770 B.P.), Beta 54166 (2960–2740 B.P.); and on shell, Beta 37561 (2750–2340 B.P.), Beta 55456 (2740–2340 B.P.), Beta 55323 (2720–2220 B.P.); from FOL (Amalut), Beta 54168 (2770–2360 B.P.). Two charcoal and *Canarium* sp. nutshell samples from FRI on Willaumez Peninsula, Beta 34208 (2110–1820 B.P.) and Beta 41590 (2320–1930 B.P.) (cf. Specht et al. 1991), fall at the end of the accepted Lapita range, consistent with other late dates reported for Watom Island (Green and Anson 1987, 1991).

If our interpretation of the "older" group is accepted, none of the above results allows a claim for placing Lapita at these West New Britain sites earlier than ca. 3260 B.P., with the possible exception of Beta 63616 at FLF (3390–2960 B.P.). This is later than the starting date of 3450–3550 B.P. accepted by Kirch and Hunt (1988a) and Spriggs (1990), which is based primarily on Kirch's Mussau excavations. We now look at dates for other Lapita sites in the Bismarck Archipelago and consider whether there is a gap between the Mussau and West New Britain dates.

LAPITA IN THE BISMARCKS

For this part of the paper we use dates already reported for the sites discussed above and other relevant dates from the Arawe sites, together with those for 14 other sites with Lapita pottery in the Bismarcks: KLK on Tuam Island in the Siassi Islands at the western end of New Britain (Lilley 1986, 1986/87); FPA on Kautaga Island and FCL on Poi Island in the Kove Islands, west of Willaumez Peninsula (Lilley 1991); the SAC and SDI sites on Watom Island (Green and Anson 1987, 1991); five unpublished dates for Lapita sites SDP, SEE, SEP, and SET in the Duke of York Islands at the eastern end of New Britain excavated by

J. P. White (Harris 1994; White 1995); and sites ECA, ECB, EHB, EKO, and EKQ in the Mussau Islands to the north of New Ireland (Kirch 1987, 1988; Kirch and Hunt 1988a, 1988b; Kirch et al. 1991). Two Lapita sites in North Solomons Province, DFF and DGD/2 on Nissan Island, along with four sites with the post-Lapita Buka style pottery (Yomining style of Spriggs), DGD/2 and DGW on Nissan and DAA and DAI on Buka Sohano Islands, are also included (Specht 1972; Spriggs 1991, 1994).

We also consider samples from five sites on New Ireland and one on Manus associated with decorated sherds similar to Lapita or with plain sherds of uncertain affinity: on New Ireland, Balof: EAB/2 (White 1992; White et al. 1991); Lasigi: ELS, ELT (Golson 1991, 1992, and pers. comm. 1994); Lamau: EFY (Gorecki et al. 1991); and Lossu Mound VI (White and Downie 1980); and on Manus, Kohin Cave: GDN, where Lapita sherds are bracketed by two samples (Kennedy 1981).

Samples from Yombon sites FGT and FIF are included to further define the age range of the W-K2 tephra, with SUA 2975 and Beta 45380 providing maximum ages and the other samples dating site reuse after the tephra event (Specht et al. 1981, 1983; Pavlides 1993; Pavlides and Gosden 1994). Beta 1545 was associated with several undiagnostic plain sherds. All of the above samples are listed in Appendix 3.

The four KLK dates differ slightly from those published by Lilley (1986/1987), which were based on assumed values for δ13C. Lilley's thesis (1986:506) also provides results based on measured values; these are used here. The sets of dates differ by 10–40 years per sample. We omit ANU 4610 on the grounds that it has no cultural association (Lilley 1986:126; Spriggs 1990) and cannot be related to the Lapita or any other use of the site. On the other hand, we include Beta 26261 from FPA and Beta 26259 from FCL, even though Lilley (1991) regarded them as not associated with the overlying Lapita deposits. At FPA Beta 26261 is stratigraphically consistent with SUA 2822 and SUA 2823 which date Lapita pottery. Beta 26261 thus provides a *terminus post quem* for the appearance of Lapita pottery on Kautaga Island. Beta 26259 from FCL is younger than all three FPA dates, but like Beta 26261 it provides a maximum age for Lapita at this site.

Several samples are problematic. Sample ANU 2248 (4070–3480 B.P.), on shell from layer 10 of Kohin Cave (GDN) on Manus, was found with plain sherds stratigraphically below Lapita dentate-stamped sherds (Kennedy 1981). Spriggs (1990) initially accepted the date but later rejected it (Spriggs 1994; cf. Ambrose 1991:105–109, who regards the site as at least partially disturbed). Inspection of the sherds from layer 10 suggests that a Lapita origin for them is possible, but this needs confirmation, as does their association with the dated sample. At this stage, ANU 2248 and charcoal sample ANU 2212 (2310 ± 120 b.p.: 2730–2000 B.P.) from layer 5 above the Lapita sherds provide a maximum range for the occurrence of dentate-stamped Lapita pottery at this site.

On Nissan, charcoal sample ANU 6802 (4870–3740 B.P.) from DFF, with a range of more than 1000 years, is much too old for Lapita. ANU 8302 (3960–3090 B.P.) from DGD/2, also on charcoal, starts well before any accepted Lapita date. Both samples probably represent the use of "old wood" or pre-Lapita use of the sites and are excluded from the discussion. Charcoal sample GX 5499 (4990–3630 B.P.) from a hearth or oven feature with Lapita sherds at the ECA site on

Eloaua Island (Bafmatuk et al. 1980) is also rejected because it is widely regarded as not referring to the pottery (Kirch and Hunt 1988a; Spriggs 1990). This sample may date old wood or refer to pre-Lapita use of the site. GX 5498 (3630–2760 B.P., on charcoal) from the same site is included because although its range of nearly 900 years makes it of limited value, its lower 5 range limit overlaps substantially with definite Lapita dates.

Beta 26644 (3470–3160 B.P.—shell) from reworked W-K2 tephra in Lolmo Cave (FOF) (Gosden et al. 1994) is included, although the dated samples from this site are stratigraphically inverted and inconsistent. The relationship between Beta 26644, the sherds, and the tephra is unclear. The tephra may pre-date the included artifacts and shells, but it is also possible that items older and younger than the tephra became included in it during the reworking process. Beta 26644 was not associated with dentate-stamped Lapita, but with incised and fingernail impressed sherds typical of a late stage of Lapita (Gosden et al. 1994).

The total number of dates is 112. Figure 2 shows the age ranges at 2 sigma for 62 shell samples, and 50 results on charcoal, wood, or nutshells are shown in Figure 3. Figure 4 shows the number of date ranges occurring in each hundred-year interval. Thus an age range of 2850–3150 B.P. is recorded in each of the intervals for 2800–2899, 2900–2999, 3000–3099, and 3100–3199. We have selected this approach rather than plotting the central tendency of each age (cf. Kirch and Hunt 1988a) in order to provide a fuller picture of the distributions of the determinations. By using the Method A calibration rather than the Method B probability approach, we avoid statistical weighting of the range determinations. A plot of the highest probability ranges using Method B would yield a result similar to that of Figure 4, but with rather fewer occurrences at the extremes of most ranges. Figure 4 does not include dates for the W-K2 tephra at FGT, FIF, and FRL; or those considered questionable or not to date Lapita, such as ANU 5339 at SAC, Beta 63613 at FFS, the earliest dates at FOJ, Beta 26644 at FOF, Beta 26261 from FPA, and Beta 26259 from FCL, ANU 2212 and ANU 2248 from GDN, and samples dating Buka (Yomining) style pottery in North Solomons Province.

The oldest shell result, Beta 63613 (3830–3470 B.P.) from FFS, was discussed above as probably dating the beach on which the Lapita occupation took place and thus provides a maximum age for the pottery at this site. The next oldest shell date is ANU 5339 (3470–3070 B.P.) from the base of a feature in the basal zone of SAC on Watom Island. This result is suspiciously old in the light of other dates from Watom, of which Beta 16836 (2870–2380 B.P.) from SDI is the oldest. With the exception of SUA 5339, the Watom dates fall within, or are younger than, the range of 2960–2360 B.P. for the four shell dates from the Duke of York Islands (SDP: SUA 3061 [2760–2360 B.P.]; SEE: SUA 3082 [2880–2740 B.P.]; SET: SUA 3063 [2850–2550 B.P.], and SUA 3064 [2960–2750 B.P.]). Green and Anson (1987:124) suggest that ANU 5339 may have been a shell on the beach prior to Lapita occupation which became incorporated in the infill of the feature (cf. Golson 1991 for ANU 5850 from ELS at Lasigi). If that is so, Lapita on Watom Island should be younger than ANU 5339.

Shell samples ANU 5088 and ANU 5089, from the Mussau area, are variously assigned to EHB (Kirch and Hunt 1988a; Kirch et al. 1991) and ECB (Kirch 1987:168). According to the EHB attribution, ANU 5088 (3470–2980 B.P.) is

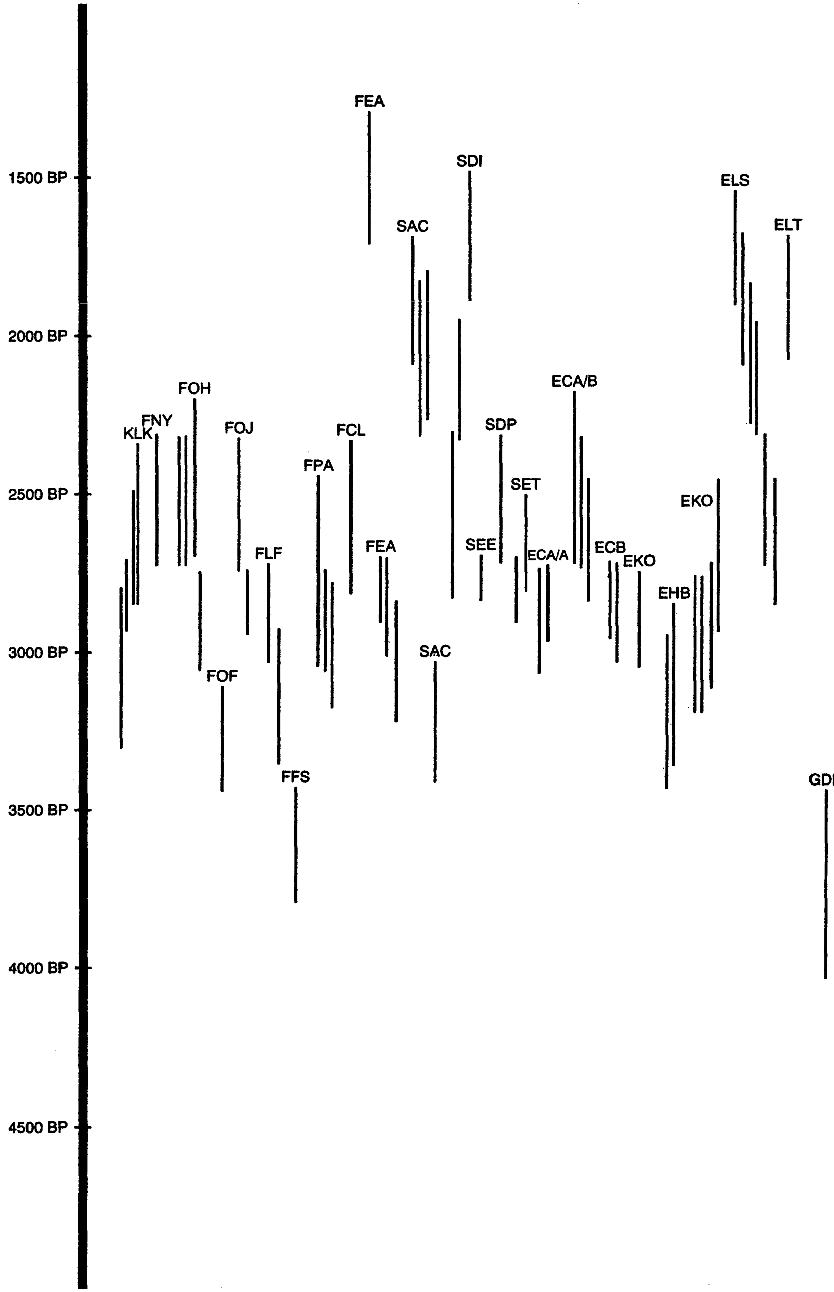

Fig. 2. Radiocarbon dates on shell for Lapita sites in the Bismarck Archipelago. Siassi Islands: KLK (Lilley 1986); Arawe Islands: FNY, FOF, FOH, FOJ (Gosden 1989, 1991; Gosden et al. 1989; Gosden and Webb 1994; Gosden et al. 1994); Kove: FCL, FPA (Lilley 1991); Willaumez Peninsula: FEA (Gosden et al. 1989; Ambrose and Gosden 1991; Specht et al. 1991); Watom Island: SAC, SDI (Green and Anson 1987, 1991); Duke of York Islands: SDP, SEE, SET (Harris 1994; White 1995); Mussau Islands: ECA, ECB, EHB, EKO, EKQ (Gosden et al. 1989; Kirch 1987, 1988; Kirch and Hunt 1988a, 1988b; Kirch et al. 1991); New Ireland: ELS, ELT (Gosden et al. 1989; Golson 1991, pers. comm. 1994); Manus: GDN (Kennedy 1981).

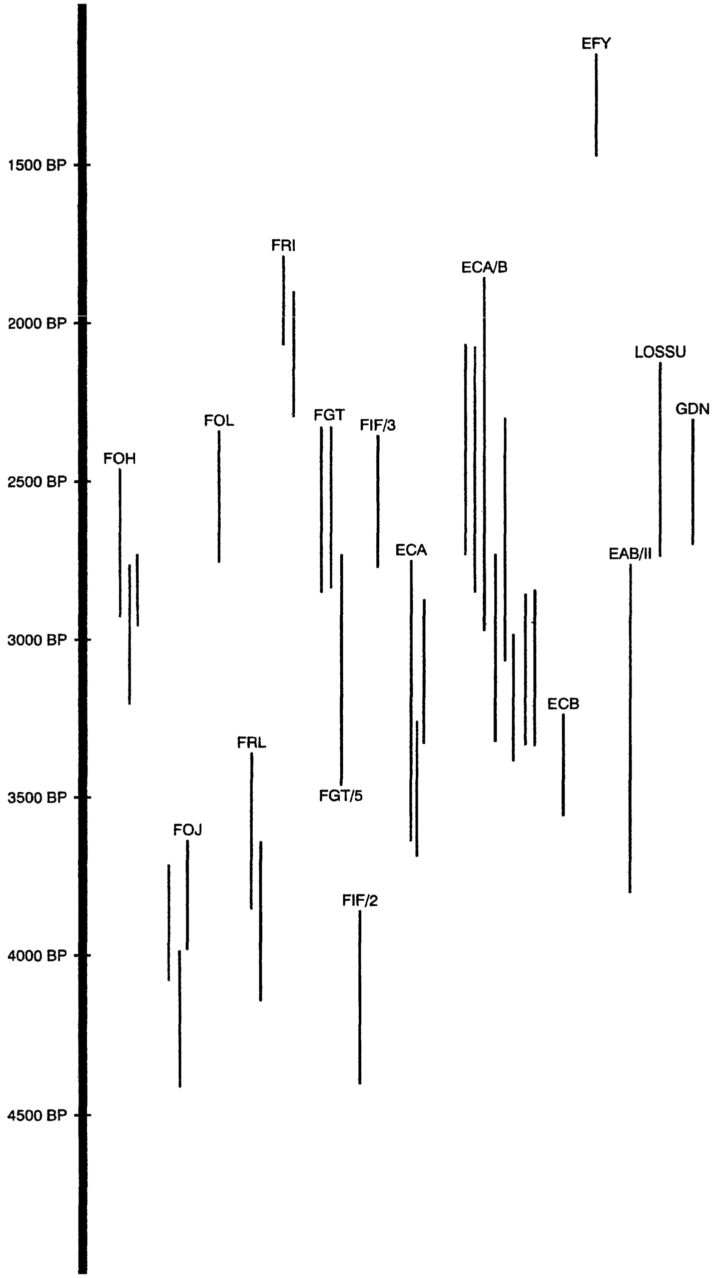

Fig. 3. Radiocarbon dates on charcoal, wood, and charred nutshells for Lapita sites in the Bismarck Archipelago. Arawe Islands: FOH, FOJ, FOL (Gosden 1989; Gosden et al. 1989; Gosden and Webb 1994); Yombon: FGT, FIF (Specht et al. 1981, 1983; Pavlides 1993; Pavlides and Gosden 1994); Willaumez Peninsula: FRI, FRL (Specht et al. 1991); Duke of York Islands: SEP (White 1995); Mussau Islands: ECA, ECB (Bafmatuk et al. 1980; Kirch 1987, 1988; Kirch and Hunt 1988a, 1988b; Gosden et al. 1989; Kirch et al. 1991); New Ireland: EFY (Gorecki et al. 1991), EAB (White et al. 1991); Lossu (White and Downie 1980); Manus: GDN (Kennedy 1981); Nissan (Gosden et al. 1989; Spriggs 1991, 1994).

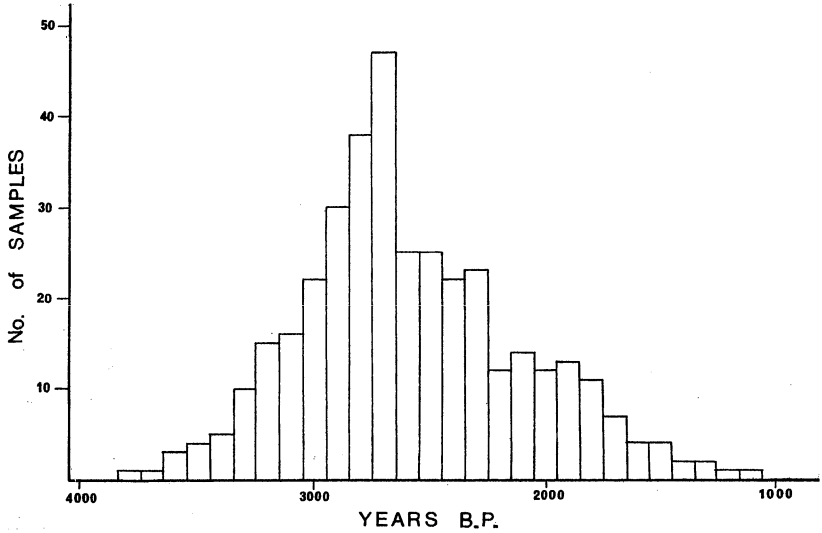

Fig. 4. Frequency histogram of date ranges per hundred-year intervals.

said to have come "from base of ceramic-bearing cultural deposit in calcareous sand matrix" (Kirch and Hunt 1988a:168). In the absence of evidence for a direct relationship between the sample and the pottery, we regard this sample as potentially beach material rather than as shell associated with the Lapita occupation. A similar possibility can be raised for ANU 5089 (3370–2870 B.P.). Both dates overlap with ANU 5339 (3470–3070 B.P.) at SAC and Beta 63616 (3390–2960 B.P.) at FLF, which were questioned above as possibly being from pre-Lapita contexts. In all four cases, however, the lower ends of their ranges overlap with those of samples with undoubted Lapita associations. The main suite of shell samples has upper range limits of 3350 and 3260 B.P. (DGD/2, KLK, FEA) or less. The two samples from FPA (Beta 26261: 3210–2800 B.P.) and FCL (Beta 26259: 2850–2370 B.P.) in the Kove Islands described as dating "culturally sterile basal sediment" (Lilley 1991:316), fall within this range. At EKQ, Beta 25670 (3220–2780 B.P.), Beta 25671 (3150–2750 B.P.), and Beta 21789 (2870–2480 B.P.) come from levels 9, 13, and 17 of the same trench, but the results are inverted. The oldest and highest of the three, Beta 25670, has a range that starts about 350 years earlier than that of the lowest sample, Beta 21789. All three overlap at 2 sigma. At DGD/2 on Nissan Island, only one of the four shell dates relating to Lapita is earlier than 3300: ANU 5228 (3350–2870 B.P.). The other three shell samples from Nissan are all younger than 3000 B.P. (DFF: ANU 5221 [2770–2350 B.P.], ANU 6804 [2120–1870 B.P.]; DGD/2: ANU 5229 [2960–2730 B.P.]).

Thus seven shell results are questioned as possibly dating non-Lapita deposits. None has an upper range limit around 3550 B.P. A starting date for Lapita of ca. 3470–3390 B.P. is acceptable only if the relevant samples at FOF, FLF, SAC, and EHB do indeed refer to Lapita presence. The main series of dates, from 22 sites across the archipelago and North Solomons, including all other Mussau dates, falls later than this at ca. 3350 B.P. and younger.

In contrast to the shell dates, the wood, charcoal, and nutshell results (Fig. 3) often have large standard deviations, resulting in wide ranges. For example, ANU 4972 (3820–2800 B.P.) at EAB/2 and ANU 5076 (2990–1890 B.P.) at ECA/B have ranges exceeding 1000 years. Such wide ranges are of little help in trying to pin down the Lapita range. Furthermore, the charcoal and wood samples have not been identified to species or to the part of tree represented, so they must be treated with caution. The possibility of "old wood" being dated is very real, especially since some samples are from timbers thought to be from structures. In recent times long-lived and very durable woods have been used for posts and beams and may yield ages not necessarily relevant to the period of use. The coconut and *Canarium* sp. nutshell samples, on the other hand, are more reliable as both are short-lived.

Doubts have already been raised about the relevance of the three early dates from FOJ in the Arawes to the appearance of Lapita pottery at the site. With the exception of the rejected sample GX 5499 (4990–3630 B.P.) at ECA and ANU 4972 (3920–2800 B.P.) for plain sherds at EAB/2, no other charcoal or wood dates overlap with them, and only three come close: ANU 5080 (3690–3270 B.P.) and GX 5498 (3630–2760 B.P.) from ECA, and Beta 20453 (3570–3260 B.P.) from ECB, both sites in the Mussau group. None of these is for a house post.

ANU 5080 (3690–3270 B.P.) is described as charcoal from a "midden" deposit with a "calcareous sand matrix in level 6 of ECA Transect Unit 9" (Kirch and Hunt 1988a:166). Describing the geomorphic and depositional history of ECA Area B, Kirch (1988:333–334) suggests that the Lapita stilt house occupation of this area began ca. 3200 B.P. (ANU 5790: 3350–2870 B.P., ANU 5791: 3340–2860 B.P., and Beta 20542: 3390–3010 B.P. for house posts), all with ranges ending considerably later than ANU 5080. If ANU 5080 is accepted, it implies that the initial Lapita occupation may have been on land and not on stilt houses over the reef, or that the earliest structures over the reef have not survived.

Charcoal sample Beta 20453 (3570–3260 B.P.) from level 5 of Unit 9 at ECB was from a "midden" with "calcareous sand matrix" (Kirch and Hunt 1988a:168). The result is older than two shell results from "pottery-bearing sand" at the same site (ANU 5086: 2970–2730 B.P., ANU 5087: 3060–2740 B.P.), possibly indicating that Beta 20453 came from "old wood."

Four charcoal dates directly associated with Lapita in the Arawe Islands of New Britain—Beta 54164 (2930–2480 B.P.), Beta 54165 (3210–2770 B.P.), and Beta 54616 (2980–2740 B.P.) at FOH, and Beta 54168 (2770–2360 B.P.) at FOL—fall within the main range of Lapita dates. SUA 3062 (2990–2740 B.P.) from SEP in the Duke of York Islands also falls within this range. On Nissan Island, three charcoal samples from DGD/2 fall between 3350 and 2210 B.P.: ANU 6137 (2790–2210 B.P.), ANU 8301 (3110–2770 B.P.), and ANU 6809 (3350–2960 B.P.).

Four charcoal samples from palaeosols below the W-K2 tephra (SUA 2975: 3470–2750 B.P. at FGT/V; Beta 45380: 4410–3860 B.P. at FIF/2; and Beta 57773: 4140–3640 B.P. and SUA 2814: 3850–3370 B.P. at FRL) have been discussed above as setting a maximum age for the occurrence of the tephra and, by extension, the appearance of Lapita pottery. Sample SUA 2975 is anomalous as it is younger than the others of this series and is the only one to overlap with the acceptable Lapita samples. The Mussau group is the only area of the Bismarcks where the age ranges for samples associated with Lapita may overlap the pre–W-K2 palaeosol dates, and then only if the earliest Mussau dates are accepted: 11 dates at ECA and ECB overlap with SUA 2975 and four with SUA 2814. Beta 1545 (2860–2350 B.P.) from FGT/I, Beta 47048 (2850–2360 B.P.) from FGT/7, and Beta 62320 (2790–2380 B.P.) from FIF/3 at Yombon place reoccupation of the sites after the W-K2 tephra within the main Lapita time range.

To summarize the wood and charcoal results, the earliest FOJ results may date very old wood or structures preceding Lapita pottery, since they form a group of their own. On New Britain, at present, there is no Lapita-associated wood or charcoal sample definitely older than the W-K2 tephra and none confirmed earlier than about 3200 B.P. (Beta 54165 from FOH: 3210–2770 B.P.). If we accept *all* the Mussau dates, on the other hand, nine of the 12 wood/charcoal dates from ECA and ECB are older than those from New Britain. The oldest charcoal date for Nissan (ANU 6809) is also slightly older than the New Britain series.

The end of Lapita is difficult to define, since there is no general agreement as to what constitutes its final stages. This is compounded by the inadequate descriptions of the pottery at most sites, with often no description of the pottery being dated. At some sites, Lapita is the only pottery present, occasionally displaying a stylistic development from dentate-stamped decoration to plain and/or incised decoration. The picture is complicated at sites such as Kohin, Lasigi, Lossu, and the North Solomons sites by the presence of pottery of apparently non- or post-Lapita origin.

At Kohin, Lapita ended before ANU 2212 (2730–2000 B.P.), with similar ranges being obtained at ECA (charcoal samples ANU 5075: 2750–2110 B.P.; ANU 5077: 2860–2110 B.P.; shell sample ANU 5083: 2740–2210 B.P.), and at Lossu Mound VI (GaK 2441: 2780–2160 B.P.), where the sample dates a redeposited Lapita sherd. In the Arawe Islands, several samples associated with pottery possibly derived from Lapita are even younger, but those reliably associated with Lapita have range limits no later than 2220 B.P. (FOH: Beta 55323, on shell). At Kandrian, Beta 79348 (2140–1890 B.P.), also on shell, is for the level above those containing Lapita sherds. The youngest series of dates comes from Watom sites SAC and SDI, FRI, and Lasigi, with 11 dates out of 16 ending after 2000 B.P. At SDI (ANU 5329: 1880–1530 B.P.), ELS (ANU 7483: 1930–1580 B.P.), FEA (ANU 5071: 1730–1340 B.P.), and EFY (ANU 5518: 2010–1190 B.P.), the pottery may end even later.

The North Solomons sites support an end for Lapita prior to about 2000 B.P. On Nissan, only one of seven definite Lapita dates (ANU 6804: 2120–1870 B.P. for DFF) ends after 2000 B.P. The post-Lapita Buka (Yomining) style may begin before ca. 2300–2700 B.P. at DGD/2, DGW, DAA, and DAI. However, if the Buka style developed out of Lapita, as is proposed by Summerhayes (1987) and Wickler (1990), there is no reason to expect that this change occurred at the same time as changes that took place at the Bismarck sites.

The date frequencies per hundred-year intervals are shown in Figure 4. The dates for the Buka (Yomining) style in North Solomons are not included in this figure. There are very few occurrences older than 3300 B.P. The peak is at 2900–2700 B.P., with a marked drop-off on each side. From 3100 B.P. until 2300 B.P., however, frequencies are all over 20. While frequencies decline thereafter, they form a long "tail" down to 1800 B.P. The youngest end of the curve, down to 1100 B.P., almost certainly reflects redeposited sherds, as FRI and FEA, and the inclusion of sites with forms of post-Lapita pottery, particularly at Lasigi (ELS, ELT). Just as samples dated for the beginning of Lapita might derive from pre-Lapita contexts, so at the younger end of the pottery distribution sherds may have become incorporated into younger sediments. Indeed, the Lossu Mound VI date is described as referring to a redeposited Lapita sherd (White and Downie 1980). The Lamau (EFY) date is very young and may reflect an "heirloom" effect (Gorecki et al. 1991).

Taking a cutoff point of 15 or more occurrences, 3300–2100 B.P. can be taken as the maximum range for Lapita in the Bismarck Archipelago and North Solomons, with the main period falling between 3100 and 2300 B.P. (20 or more occurrences) and the peak at 2900–2700 B.P. By 2300–1800 B.P. the pottery had changed stylistically at many sites, and at some (e.g., Kohin Cave GDN) quite different styles had emerged. Whereas in its beginning stages Lapita pottery was remarkably uniform throughout its distribution, toward its end it diversified considerably and new styles emerged or were introduced. The Buka (Yomining) style provides an illustration of this. Of ten dates for this pottery, two (ANU 5227 and ANU 5226) are rejected as anomalously too young. When the remaining dates are plotted by hundred-year intervals, they show a steady frequency of five to eight occurrences from 2700 B.P. until 1900 B.P., peaking at seven to eight at 2200–2100 B.P.

DISCUSSION

Age determinations are reckoned as probability distributions, a fact which has two implications. First of all, we are matching different distributions to look for patterns in them, rather than dealing with point determinations which will easily give us delimited periods with clear beginnings and ends. Second, it is only with sufficient sample sizes that general patterns in the distributions can be discerned. We believe that we have reached this situation in the Bismarck Archipelago for the Lapita period, and that the patterns we can now discern in the data can be used to set up hypotheses for future testing.

The accepted Lapita starting date of 3450–3550 B.P. is questioned by the results from New Britain. Lapita occupation of the New Britain sites may have begun no earlier than ca. 3300–3200 B.P., somewhat later than in the Mussau group. Given the similarities between the Mussau and Arawe pottery, however, we find this proposition unlikely. On the other hand, if our questioning of the oldest Mussau dates is accepted, Lapita throughout the Bismarcks may have begun about 200–300 years later than currently accepted. In support of our position is Kirch's own data for the waterlogged basal zone C at ECA and Kirch's own statement (1988) that the building of stilt houses at ECA began ca. 3200 B.P. Nine samples are published as referring to zone C. The oldest of these are the three posts dated as Beta 20452, ANU 5790, and ANU 5791, which all fall between 3390 and 2860 B.P. The nature of the dated wood is not given, but even if it was the surviving outside part of the posts, this cannot be assumed to represent the youngest growth of the trees prior to their being cut down. The posts, therefore, should be regarded as younger than the maximum of their age ranges. Furthermore, of the other six dates for zone C (ANU 5075, 5076, 5077, 5078, 5079, 5081), all on charcoal (with one exception on shell), only one (ANU 5079: 3330–2750 B.P.) has a range older than 3070 ± 14 B.P. Zone C is best regarded, therefore, as not predating ca. 3200 B.P.

A revised starting date of 3300–3200 B.P. in the Bismarcks obviously affects interpretation of how quickly Lapita pottery spread into areas to the south and east, and whether there was a short "pause" in the Bismarcks. Without reviewing in detail all dates for Lapita in more southerly sites, we note that a later start in the Bismarcks does not conflict with dates for southerly sites. In the southeastern Solomons, Green (1991:203) opts for a starting date of about 3150 B.P. Thus Lapita shows a virtually instantaneous expansion into the Solomons. This does not allow time for a "pause" in the Bismarcks for Anson's (1986) proposed "Far Western Lapita." Spriggs (1990:20) accepts 3050–2950 B.P. for island groups to the south of the Solomons. While we acknowledge the paucity of dates for Vanuatu, even if Lapita is shown to have reached Vanuatu and New Caledonia at about the same time as its appearance in the Bismarcks and the Solomons, its arrival in Western Polynesia may have been about 200 or so years after it appeared in the Bismarck Archipelago (cf. Spriggs 1990). The possibility of such a "pause" in its expansion between Vanuatu/New Caledonia and Western Polynesia may have a bearing on the development of Green's (1979) western and eastern divisions of Lapita pottery and the effect of distance as it was socially conceived on the differentation of assemblages. What is clear, however, is that the revised chronology offered here reinforces the extremely rapid spread of Lapita discussed by Kirch and Hunt (1988a).

The current data, however, are not free from problems, especially for the calibration of marine shell dates. The shell dates have been calibrated with the atmospheric curve after deducting 400 years for the Ocean Reservoir Effect. This value needs further confirmation or replacement with a Delta R value calculated specifically for the study region. Also needing attention is the possible effect of groundwater and the influence of the geological context of mollusc habitats recently suggested by Dye (1994) for the Hawaiian Islands. Use of the 400-year value has automatically made the shell dates slightly younger, by 100–150 years at the top end of a range, than those discussed by Spriggs, who used the marine δ curve with Delta $R = 0 \pm 0$. Our approach produces results closer to those based on Delta $R = 100 \pm 24$ years (Kirch and Hunt 1998a, 1988b; cf. Spriggs 1990:16). However, the fact that our ages are slightly younger than those of Spriggs is not solely due to our calibration approach. An earlier version of this paper using the marine curve with Delta $R = 0 \pm 0$ and following the same lines of sample assessment yielded a result similar to that presented here. The reliability of the dated sample contexts is also a major issue. More dates from secure contexts are needed, so that claimed associations between samples and artifacts can be demonstrated. This includes wood and charcoal samples that may derive from long-lived trees or from beach flotsam of much older age than the silts into which they became incorporated.

There is also a problem in defining the end of Lapita pottery. In some cases Lapita was transformed into another style, as appears to have occurred in the North Solomons. In other situations it was followed by a distinctively different style, as is claimed for the Manus area, or pottery simply ceased to be used, as appears to be the case at sites near Talasea. The "end" of Lapita, therefore, cannot be regarded as an event, but as an outcome of several processes. There is no *a priori* reason why any of these occurred at the same time throughout the archipelago, and we should expect the terminal date to vary from one area to another.

CONCLUSION

The beginning of Lapita pottery in the Bismarck Archipelago thus cannot be placed reliably earlier than about 3300–3200 B.P., certainly not as early as the 3550 B.P. date preferred by Kirch and Hunt. While it is not our purpose here to trace possible precursors or ancestors of Lapita to the west of the Bismarck Archipelago, we note that in the northern Maluku area, red-slipped pottery similar in vessel and rim forms to Lapita has been reported at a time contemporary with Lapita (Bellwood 1992; Bellwood et al. 1993). We hesitate to calibrate Bellwood's dates, but note that the three oldest samples for this pottery (ANU 7776: 3440 ± 110 b.p.; ANU 7775: 2610 ± 170 b.p.; and ANU 7785: 2540 ± 70 b.p.) do not conflict with our proposed revised date for Lapita in the Bismarcks.

We return to the possibility of Lapita being slightly older in the Mussau area than in New Britain. New Britain obsidian occurs in the earliest levels of the Mussau sites. Given the apparent absence of Lapita sites in New Britain at that time, this may mean that New Britain obsidian was traded to Mussau by non–Lapita-using people. If so, it would suggest that ECA, ECB, and EHB fitted into a preexisting exchange network (cf. Allen and White 1989). There is ample evidence for the pre-Lapita movement of New Britain obsidian within New Britain itself at Misisil (Specht et al. 1983), Lolmo (Gosden et al. 1994), and the Kandrian rockshelters FLF and FLQ in the terminal Pleistocene–mid Holocene, and even across St. Georges Channel to New Ireland in the late Pleistocene (Summerhayes and Allen 1993). The possibility remains, however, that there are Lapita sites on and around New Britain as early as those in the Mussau group which have yet to be located.

One of the earliest dates at FOH was interpreted as possibly coming from a pre-Lapita stilt structure over the reef. There is unequivocal evidence for pre-Lapita mid-Holocene use of the south coast of New Britain at Lolmo, on the beach at FNY on Pililo Island, and in rockshelters FLF and FLQ near Kandrian. If our interpretation of the FOH evidence is correct, it indicates that this kind of settlement had a pre-Lapita origin and adds further doubts about the unique contribution of the "Lapita cultural complex" in this region. In this context we note that the earliest stilt structures in the Mussau area appear to be slightly younger than the FOH evidence. There are now at least eight sites with both Lapita and pre-Lapita levels in West New Britain. These include open sites, shelters, a cave, and now, importantly, one reef site. These sites will allow us to start to disaggregate Lapita sites and their contents and to discuss how various elements have had different histories as introductions or as changing elements with continuity with the past. A problem with estimating continuities between pre-Lapita and Lapita archaeology from the evidence of beaches hitherto has been that the sea level only stabilized shortly before, or during, the Lapita period. The Apalo evidence, however, now suggests that people were building structures out over reefs shortly after the reefs reached their present levels and before the introduction of Lapita pottery. This initial use of Apalo has other continuities with the succeeding Lapita occupations in terms of the obsidian, chert, shell, and plant remains. It also shares material culture in common with other immediately pre-Lapita sites in West New Britain (Gosden et al. 1994; Specht et al. 1991). Further afield in the Bismarck Archipelago, continuities between pre-Lapita and Lapita periods also exist in several artifact types. Shell tools and polished stone are now known from late Pleistocene contexts on Manus (Fredericksen et al. 1993), as well as in the use and transport of New Britain obsidian as noted above. The one category that makes a sudden entry into the material culture repertoires of the region with the start of the Lapita period is the pottery itself.

For West New Britain and probably for other parts of the archipelago, Lapita assemblages represent not a single package, given unity by a unique commonality of culture, but a series of elements of life in which there was differential participation. Hence, there are sites, as in the Arawe and Mussau areas, that are rich in Lapita pottery; and others, such as at Kandrian and in the Manus area and on New Ireland, with only a few sherds. Pottery, as part of material culture, was undoubtedly used for social as well as practical purposes, and those purposes were not everywhere the same. Such a view helps explain those large areas where pottery of any kind is lacking throughout the Lapita period, as on Guadalcanal in the Solomons (Roe 1992). Either the occupants of these regions decided that pottery was something they could do without, or something to which they had little or no access.

The complex situation in the Bismarcks after dentate-stamped decoration went out of use may also be explained by the different roles that pottery had. The diversification of pottery styles may indicate more local production, exchange, and use, perhaps reflecting a realignment of areal relationships. The fact that in some areas pottery went permanently out of use suggests that pottery as both a container and a medium of symbolism and exchange was an option and not a necessity.

Archaeological sites and their assemblages represent a series of components combined in different ways depending on factors arising from the social system. The dates from pre-Lapita and Lapita sites in the Bismarck Archipelago are beginning to allow us to see how and when the components of Lapita assemblages were put together, rather than arriving as a coherent package.

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ABSTRACT

Dates for the appearance of Lapita pottery suggest a rapid expansion from the Bismarck Archipelago in the north to Western Polynesia in the south. Kirch and Hunt (1988a, 1988b) see this as instantaneous in archaeological and radiocarbon terms, but Spriggs (1990) proposes a "pause" in the Bismarck Archipelago. We review the dates from the Bismarck area and note that two interpretations are possible, depending on which dates are accepted. Lapita pottery may have begun there later than the accepted date of cal. 3450–3550 B.P., or it could have begun in the Mussau Islands earlier than in New Britain. Both views raise questions about Lapita presence in this region and have implications for its spread to more southerly islands. A maximum time range of from cal. 3300 to 2100 B.P. is suggested for the Bismarck Archipelago, with most dates falling between 3100 and 2300 B.P. The end date of Lapita is problematical, since it depends on how the end is defined. The paper concludes with some observations on the implications of the revised dating for understanding Lapita sites. KEYWORDS: dating, calibration, Lapita, shell, charcoal.

Appendix 1. West New Britain Radiocarbon Dates

SITE NAME	SITE CODE	LAB SAMPLE #	δ13C VALUE[a]	CONVENTIONAL AGE (b.p.)[b]	CALIBRATED AGE (B.P.)[c]	SUMMARY DESCRIPTION OF SAMPLE MATERIAL AND CONTEXT
Arawe Islands						
Makekur	FOH	Beta 37561	+0.2‰	2860±70	2750–2340	*Tridacna* sp. shell. Square G, spit 6.
		Beta 54164	−29.0‰	2640±90	2930–2480	Charcoal. Square G2, spit 13.
		Beta 54165	−28.6‰	2850±80	3210–2770	Charcoal. Test Pit 21B, spit 13.
		Beta 54166	−26.9‰	2730±70	2960–2740	Charcoal. Test Pit 21B, spit 17.
		Beta 55323	+1.0‰ (E)	2800±70	2720–2220	Marine shell. Square D1, spit 10.
		Beta 55456	+2.4‰	2840±60	2740–2340	*Tridacna* sp. shell. Test Pit 28, spit 14.
Apalo	FOJ	Beta 37560	−31.2‰	3580±60	4070–3700	Charcoal. Square U1, spit 20.
		Beta 54170	−27.4‰	3800±60	4410–3980	Charcoal. Square U4, spit 22.
		Beta 55457	−28.1‰	3540±60	3980–3640	Waterlogged wood. Square L2, spit 17.
Amalut	FOL	Beta 54168	−28.1‰	2530±70	2770–2360	Charcoal. Test Pit 4, spit 17.
Kandrian						
Auraruo	FFS	Beta 63613	+0.4‰	3810±60	3830–3470	*Anadara antiquata* shell. Test Pit 15N20E, spit 4.
Alanglongromo	FLF	Beta 57767	−1.00‰	3170±70	3060–2750	*Anadara antiquata* shell. Test Pit IA, layer 5, spit 2.
		Beta 63616	−1.00‰	3430±80	3390–2960	*Anadara antiquata* shell. Test Pit IB, layer 5, spit 3.
		Beta 79348	+1.6‰	2470±50	2140–1890	*Spondylus* sp. shell. Test Pit IA, layer 4.
Yonbon						
Auwa	FGT	SUA 2975	−25.00‰ (E)	2940±160	3470–2750	Charcoal. Trench V, layer 6.
Willaumez Peninsula						
Garua Island	FEL	Beta 42526	−25.00±−2.00‰ (E)	1050±80	1130–780	Charcoal. Test Pit I, layer 3, spit 2.
Boduna Island	FEA	Beta 41578	+1.0‰	3330±60	3260–2880	*Chama* sp. shell. Trench I, layer 4, spit 2.
Bitokara Mission	FRL	Beta 57773	−27.3‰	3590±90	4140–3640	Charcoal. Unit 4, square NEa, spit 12.
		SUA 2814	−25.00±−2.00‰ (E)	3370±100	3850–3370	Charcoal. Unit 4, square NEc, spit 12.
Walindi	FRI	Beta 41590	−25.00±−2.0‰ (E)	2130±70	2320–1930	*Canarium* sp. nutshells. Associated with earth oven in Trench II, layer 3, spit 3.
		Beta 34208	−25.00±−2.0‰ (E)	2000±60	2110–1820	Charcoal and *Canarium* sp. nutshells. Associated with earth oven in Trench II, layer 3, spit 2.

[a] E = estimated.
[b] Conventional age adjusted for δ13C in years b.p.
[c] Age calibrated by deducting an Ocean Reservoir Effect (ORE) value of 400 years and then using the atmospheric curve, expressed in years B.P. as a 2-sigma range.

Appendix 2. Dates Rejected

LAB SAMPLE #	δ13C VALUE	CONVENTIONAL AGE (b.p.)	CALIBRATED AGE (B.P.)	SUMMARY DESCRIPTION OF SAMPLE MATERIAL AND CONTEXT
NZA 1979	−27.2‰	76 ± 56	98.6 ± 0.7% modern	Waterlogged wood. Base of Test Pit I at 121–153 cm.
SUA 2976	−0.0 ± −2.0‰	80 ± 160	Modern	Charcoal. Trench I, layer 3, spit 3.
NZA 450	−27.82‰		100 ± 1.8% modern	Charcoal. Unit 6

Note: Three dates were rejected, as they gave modern results when they were expected to be prehistoric on stratigraphic grounds or due to artifactual associations (these are discussed further in the text).

Appendix 3. Bismarck Dates Relevant to Lapita Pottery

SITE NAME	SITE CODE	LAB SAMPLE #	CONVENTIONAL AGE (b.p.)	CALIBRATED AGE (B.P.)[a]	SUMMARY DESCRIPTION OF SAMPLE MATERIAL AND CONTEXT
Siassi Islands					
Tuam Island	KLK	ANU 4617	3010 ± 80	2960–2730	Marine shell. Test Pit II, unit 4 (130 cm).
		ANU 4620	3040 ± 70	2860–2510	Marine shell. Test Pit III, unit 4 (69 cm).
		ANU 4621	3300 ± 80	3320–2800	Marine shell. Test Pit III, unit 4 (130 cm).
		ANU 4664	3000 ± 100	2870–2360	Marine shell. Test Pit III, unit 4 (132 cm).
Arawe Islands					
Pililo Island—Paligmete	FNY	Beta 27940	2870 ± 70	2750–2340	Oyster shell. Test Pit 1, spit 13.
Kumbun Island—Lolmo	FOF	Beta 26644	3530 ± 70	3470–3160	*Anadara antiquata* shell. Square E, unit 4.
Kumbun Island—Apalo	FOJ	Beta 29244	2960 ± 80	2760–2350	*Tridacna* sp. shell. Square 03, spit 13.
		Beta 29245	3230 ± 50	2960–2760	*Tridacna* sp. shell. Square 03, spit 17.
Adwe Island—Makekur	FOH	Beta 27946	3200 ± 70	3080–2760	Oyster shell. Test Pit 1, spit 11.
Yombon					
Auwa	FGT	Beta 1545	2575 ± 100	2860–2350	Charcoal. Trench 1, layer 5, palaeosol on W-K2 tephra.
		Beta 47048	2570 ± 90	2850–2360	Charcoal. Trench 7, layer 5, palaeosol on W-K2 tephra.
Airstrip	FIF	Beta 45380	3760 ± 90	4410–3860	Charcoal. Trench 2, layer 6, below W-K2 tephra.
		Beta 62320	2580 ± 70	2790–2380	Charcoal. Trench 3, layer 4, palaeosol on W-K2 tephra.

Kove Islands					
Poi Island	FCL	Beta 26259	2990±80	2850–2370	Marine shell. Beach below Lapita level.
Kautaga Island	FPA	Beta 26261	3280±70	3210–2800	Marine shell. Beach below Lapita level.
		SUA 2822	3100±120	3080–2780	Marine shell. Lapita level.
		SUA 2823	3220±70	3110–2770	Marine shell. Lapita level.
Willaumez Peninsula					
Boduna Island	FEA	ANU 5071	2050±90	1730–1340	Marine shell. 60–70 cm below surface.
		ANU 5072	3090±80	2950–2720	Marine shell. 60–70 cm below surface.
		ANU 5073	3130±90	3060–2730	Marine shell. 50–60 cm below surface.
Watom Island					
Kainapirina	SAC	ANU 5330	2390±80	2130–1730	*Tridacna* sp. shell. Base of zone C1.
		ANU 5336	2530±90	2340–1880	*Tridacna* sp. shell. Base of zone C2; same shell as Beta 16835.
		Beta 16835	2470±75	2300–1840	*Tridacna* sp. shell. Base of zone C2; same shell as ANU 5336.
		ANU 5339	3490±80	3470–3070	*Tridacna sp*. shell. Feature in zone C2.
Vunavaung	SDI	ANU 5329	2190±80	1880–1530	*Hippopus* sp. shell. Layer 3.
		ANU 6475	2630±80	2360–2000	*Trochus niloticus* shell. Layer 3.
		Beta 16836	3020±90	2870–2380	*Tridacna* sp. shell. Layer 4.
Duke of York Islands					
Kabilomo	SDP	SUA 3061	2940±60	2760–2360	*Tridacna ?gigas* shell. Layer 7.
Kabakon	SEE	SUA 3082	3090±60	2880–2740	*Strombus luhuanus* shell. Layer 5.
Uraputput	SEP	SUA 3062	2730±80	2990–2740	Charcoal. Layer 1.
Nakukur	SET	SUA 3064	3150±60	2960–2750	*Tridacna ?gigas* shell. Layer 3.
		SUA 3063	3030±60	2850–2550	*Tridacna ?gigas* shell. Layer 2.
Mussau Islands					
Eloaua—Talepakemalai	ECA	GX 5498	3030±180	3630–2760	Charcoal. Hearth or oven.
		ANU 5080	3260±90	3690–3270	Charcoal. Transect Unit 9, unit 6.
		Beta 20451	2950±70	3340–2880	Coconut shell. Transect Unit 18, unit 9.
		ANU 5084	3190±80	3100–2750	*Tridacna gigas* shell. Area A, square W228N102, unit 3.
		ANU 5085	3130±80	2990–2740	*Pycnodonta* sp. shell. Area A, square W229N100, unit 9.
		ANU 5082	2950±80	2750–2330	*Pycnodonta* sp. shell. Area B, square W201N149, unit 12.
		ANU 5083	2810±80	2740–2210	*Pycnodonta* sp. shell. Area B, square W200N149, zone B1.
		ANU 5075	2370±120	2750–2110	Charcoal. Area B, square W200N149, zone C1.
		ANU 5079	2840±115	3330–2750	Charcoal. Area B, square W200N150, zone C1.
		ANU 5076	2430±230	2990–1890	Charcoal. Area B, square W200N151, zone C1.

(continues)

APPENDIX 3. *Continued.*

SITE NAME	SITE CODE	LAB SAMPLE #	CONVENTIONAL AGE (b.p.)	CALIBRATED AGE (B.P.)[a]	SUMMARY DESCRIPTION OF SAMPLE MATERIAL AND CONTEXT
		ANU 5081	3010±80	2860–2470	*Tridacna* sp. shell. Area B, square W200N151, zone C3.
		ANU 5077	2450±160	2860–2110	Charcoal. Area B, square W201N151, zone C1.
		ANU 5078	2600±160	3070–2330	Charcoal. Area B, square W199–200N150, zone C2–C3.
		Beta 20452	3050±70	3390–3010	Wood. Area B, square W198N148, Post 30, zone C.
		ANU 5790	2950±80	3350–2870	Wood. Area B, square W198N148, Post 1, zone C.
		ANU 5791	2930±80	3340–2860	Wood. Area B, square W198N148, Post 2, zone C.
Eloaua Island	ECB	Beta 20453	3200±70	3570–3260	Charcoal.
		ANU 5086	3120±80	2970–2730	*Pycnodonta* sp. shell. Test Unit 1, level 1.
		ANU 5087	3150±80	3060–2740	*Pycnodonta* sp. shell. Test Unit 1, level 2.
Eloaua Island	EKO	Beta 25669	3200±70	3080–2760	Marine shell. Test Unit 1, level 4.
Emananusa Island	EHB	ANU 5088	3470±90	3470–2980	*Tridacna gigas* shell. Test Unit 1, level 9.
		ANU 5089	3380±90	3370–2870	*Pycnodonta* sp. shell. Test Unit 2, level 6.
Mussau Island	EKQ	Beta 20454	3280±70	3210–2800	Marine shell. Test Unit 1, level 11.
		Beta 25670	3270±80	3220–2780	Marine shell. Test Unit 2, level 9.
		Beta 25671	3190±90	3150–2750	Marine shell. Test Unit 2, level 13.
		Beta 21789	3030±80	2870–2480	Mix of *Strombus, Turbo, Quidnipagus* shells. Test Unit 2, level 17.
New Ireland					
Balof	EAB/2	ANU 4972	3120±190	3820–2800	Charcoal. Horizon II, with "plainware."
Lamau	EFY	ANU 5518	1680±200	2010–1180	Organo-metallic compound from inside pot with Lapita-like incised decoration.
Lossu	Mound VI	GaK 2441	2460±120	2780–2160	Charcoal. With secondarily deposited Lapita sherd.
Lasigi—Dori site	ELS	ANU 5850	2870±80	2750–2340	Marine shell. Phase 3 post-hole fill.
		ANU 5851	2370±80	2120–1720	Marine shell. Lower Phase 4.
		ANU 7482	2580±70	2340–1990	Marine shell.
		ANU 7483	2250±70	1930–1580	Marine shell.
		ANU 7484	2470±70	2300–1870	Marine shell.
		ANU 7485	3040±80	2870–2490	Marine shell.
Lasigi—Mission site	ELT	ANU 5852	2370±80	2120–1720	Marine shell. Top of Phase 3.
Manus Island					
Kohin Cave	GDN	ANU 2212	2310±120	2730–2340	Charcoal. Layer 5, above Lapita sherds.
		ANU 2248	3900±100	4070–3480	Marine shell. Layer 10, with plain sherds, below Lapita.
Nissan Island					
Lebang Halika	DFF	ANU 5221	2920±80	2770–2350	Marine shell. Square 3, 30–50 cm below surface.
		ANU 6804	2430±50	2120–1870	Marine shell. Square 7, 20–30 cm below surface.
Yomining	DGD/2	ANU 5227	1590±70	1280–940	Marine shell. Square 2, 55–65 cm below surface, with post-Lapita Buka (Yomining) Style sherds.

		ANU 5228	3350±80	3350–2870	Marine shell. Square 2, 90–100 cm below surface.
		ANU 5229	3110±80	2960–2730	Marine shell. Square 2, 145–164 cm below surface.
		ANU 6808	1970±210	2360–1410	Charcoal. Square 4, 50–60 cm below surface, with Buka (Yomining) Style sherds.
		ANU 6810	2460±130	2790–2150	Charcoal. Square 4, 60–70 cm below surface, with Buka (Yomining) Style sherds.
		ANU 6136	2440±110	2760–2160	Charcoal. Square 4, 70–80 cm below surface, with Buka (Yomining) Style sherds.
		ANU 6137	2480±120	2790–2210	Charcoal. Square 4, 90–100 cm below surface.
		ANU 8301	2820±70	3110–2770	Charcoal. Square 4, 100–110 cm below surface.
		ANU 6809	1990±60	3350–2960	Charcoal. Square 4, 110–120 cm below surface.
		ANU 7863	2080±150	2350–1700	Charcoal. Square 6, 50–60 cm below surface, with Buka (Yomining) Style sherds.
Lebang Tatale	DGW	ANU 5226	1310±100	1390–980	Charcoal. Square 2, 140–150 cm below surface, with Buka (Yomining) Style sherds.
		ANU 6799	2400±210	2930–1900	Charcoal. Square 2, 190–200 cm below surface, with Buka (Yomining) Style sherds.
		ANU 5223	1860±150	2140–1410	Charcoal. Square 3, 170–180 cm below surface, with Buka (Yomining) Style sherds.
Buke Island					
Hangan	DAI	ANU 234	2190±140	2700–1840	Charcoal. Trench B, layer VI, with Buka Style sherds.
Sohano Hospital	DAA	ANU 272	2480±140	2850–2150	Charcoal. Trench II, layer 5, with Buka Style and Lapita sherds.

Note: All samples said to be associated with Lapita pottery unless otherwise stated.
[a] Calibrated ranges at 2 sigma. Marine shell samples have been calibrated by deducting 400 years for ORE, then applying the atmospheric curve.